Title: All Averages Are Not Created Equal

Brief Overview:

Students will calculate the mean, median, and mode and select the most appropriate characteristic for a given problem context or data set.

Links to Standards:

- **Mathematics as Problem Solving**
  Students will use logical reasoning and statistical methods to select a most appropriate value.

- **Mathematics as Communication**
  Students will provide rationale for their approach and selection of a particular statistical method in response to a problem situation.

- **Mathematics as Reasoning**
  Students will follow logical mathematical procedures and conclusions with emphasis placed on deductive reasoning.

- **Mathematical Connections**
  Students will recognize and create problems from real-life data and situations within and outside mathematics. They will then apply appropriate strategies to find an acceptable solution.

- **Statistics**
  Students will learn to select the appropriate measure of central tendency**.**

Grade/Level:

Algebra, Grades 7-10

Duration/Length:

This activity will take two 45 minute periods or one 90 minute period. The activities may take longer than anticipated depending upon students' prior knowledge.

Prerequisite Knowledge:

Students should have a working knowledge of the following:

- Statistical capabilities of the TI-82, TI-83, or other statistical calculator
- Construction of scatter plots (for follow-on lessons only).

Objectives:

Students will:

- work cooperatively in groups.
- organize and analyze data to calculate mean, median, and mode.
- use logical reasoning to determine the appropriate average for a given situation.
- provide justification for results and conclusions.

Materials/Resources/Printed Materials:

- TI-82/83 or any statistical calculator
- Student worksheets.
- Teacher Resource: TI-82/83 overhead (optional)

Development/Procedures:

- Define mean, median, and mode.
- Demonstrate with examples.
- Discuss advantages/disadvantages of each measure of central tendency.
- Conduct practical exercise #1 (finding mean, median, mode).
- Conduct exercise # 2 and 3 (determine appropriate/inappropriate averages).

Performance Assessment:

Students will be evaluated on completion of worksheets, graphs produced, development of mathematical model (follow-on only) , and written summary of conclusions.

Extension/Follow Up:

- Use Chicken Nutrition Data or Automobile Quality data to determine correlation between weight and calories or cost and complaints, respectively.

- Compare the median-median line to the linear regression line (base on the mean) using the TI-82 or TI-83 graphing calculator.

- Discuss the appropriateness of each method (median-median and least squares regression).

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LESSON OUTLINE

Definitions

Mean - average value of a set of numbers, obtained by adding their values together and dividing this sum by the number of values added.

Median - the middle number in a data set (in ascending / descending order) with an odd number of values; and the average of the middle two values in a data set with an even number of values.

Mode - the data element or elements that occur the most often. If no element occurs more frequently than any other, there is no mode. There may be more than one mode.

Discuss the advantages and disadvantages of each type of average.

Example 1

Data:

3, 4, 5, 9, 7, 8, 4

Step 1: Order the data

3, 4, 4, 5, 7, 8, 9

Step 2: Find each of the three averages

Mean	40/7
Median	5
Mode	4

Example 2

Data:

3, 4, 5, 5, 4, 6

Step 1: Order the data

3, 4, 4, 5, 5, 6

Step 2: Find each of the three averages

Mean	27/6
Median	(4 + 5)/2 = 4.5
Mode	4 and 5

EXERCISE #1
(Determining mean, median, mode)

Calculate the mean, median, and mode (when appropriate) for each set of data. Sets D and E contain multiple data sets.

Set A	Set B	Set C
14, 18, 12, 18, 14, 25, 32, 18, 16	10,000 10,000 10,000 12,000 58,000	4 Hot Dogs 3 Steaks 13 Pizzas
Mean _____	Mean _____	Mean _____
Median _____	Median _____	Median _____
Mode _____	Mode _____	Mode _____

Set D

The most trouble-free 1991 car models sold in the USA

Model / Base Price		Problems / 100 Cars
1. Lexus LS400	$39,000	47
2. Acura NSX	$61,000	71
3. BMW 750iL	$74,600	74
4. Lexus ES250	$21,500	76
5. Mercedes-Benz S	$63,600	77
6. Infiniti Q45	$40,000	78
7. Pontiac 6000	$12,999	78
8. Toyota Camry	$12,198	79
9. Toyota Cressida	$22,698	80
10. Honda CRX`	$ 9,325	89
11. Mercedes-Benz 190E	$28,050	89

J.D. Power Associates Data. Extracted from Data Resource For Teaching Statistics, Dale Seymour Publications.

Mean _____ Median _____ Mode _____

Set E

Chicken Nutrition

Chicken Item	Weight	Calories	Fat (g)
Hardee's Grilled Sandwich	192	310	9
Hardee's Fillet	173	370	13
Wendy's Grilled Sandwich	175	340	13
Wendy's Sandwich (Reg)	219	430	19
Burger King BK Broiler	168	379	18
McDonald's McChicken	187	415	20
McDonald's McNuggets (6)	113	270	15
Burger King Sandwich	229	685	40
KFC Lite 'n Crispy[1]	72	198	12
KFC Original Recipe[1]	92	248	15
KFC Extra Crispy[1]	108	324	21

[1]KFC figures average four kinds of chicken pieces: sidebreast, centerbreast, drumstick, and thigh.
Extracted from Data Resource For Teaching Statistics, Dale Seymour Publications.

Mean _____

Median _____

Mode _____

EXERCISE #2

INSTRUCTIONS: Based on the context of each problem, select and calculate the most appropriate measure of central tendency. Explain why this is the best measure to use.

1. The local Dress Rack store conducted an inventory of their sales to determine which sizes to order for the fall season. The following data represent the number of dresses sold this month by size.

Size	# Dresses Sold
4	8
6	23
8	12
10	35
12	3

Find the "average" size dress sold.

2. The Shoestring Postcard Company has ten employees. They need to hire 1 additional production worker and want to include the average annual salary in their help wanted advertisement. The following table lists the annual salaries of the current staff.

CEO	$120,000
Vice Pres.	$ 80,000
Production Workers	$ 30,000
(By seniority)	$ 28,000
	$ 25,000
	$ 20,000
	$ 20,000
	$ 15,000
	$ 15,000
	$ 10,000

Which measure of central tendency (average) would the CEO like to publish in his advertisement if he wants to appear to be paying well?

3. The Shoestring Postcard Company's representative to the local Union of Printing Workers wants to insure that the average salary contained in the advertisement accurately reflects what the new employee can expect to earn. Which average does she want to see in the Help Wanted Ad?

EXERCISE #3

Each of the three measures of central tendency we have discussed can correctly be called an average, and each has particular advantages or disadvantages in certain situations. Based on these properties of the Mean, Median, and Mode complete the following:

1. Describe a situation and provide a sample data set of at least 10 elements for which the MEDIAN is the most appropriate average.

2. Describe a situation and provide a sample data set of at least 10 elements for which the MODE is the most appropriate average.

3. Describe a situation and provide a sample data set of at least 10 elements for which the MEAN is the most appropriate average. Additionally, provide one reason why the mean is the most often used average.